

Association between long-term environmental Mn exposure and verbal fluency in community-dwelling adults

Erica S. Kornblith¹ and Rosemarie M. Bowler²

¹California School of Professional Psychology at Alliant International University

²San Francisco State University

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This study examined the impact of environmental manganese (Mn) exposure on verbal fluency among long-term residents of three towns in Southeastern Ohio, USA. Data was obtained from a larger EPA-sponsored study comparing two towns exposed to environmental Mn, Marietta and East Liverpool, with a third, unexposed control town (Mt. Vernon). **Background:** Mn is a naturally-occurring element that is essential for normal functioning (ATSDR, 2000) but is toxic in large doses. Mn accumulates in the brain overtime and excessive exposure is associated with parkinsonian-like motor symptoms (Feldman, 1999), cognitive disturbance including executive dysfunction (Mergler et al., 1994), mood symptoms (Bowler et al., 2007), and adverse physical health consequences (ATSDR, 2000).

Most of what is known about the neurotoxic effects of Mn comes from occupational studies, and environmental exposure to Mn generally occurs at a lower dose and over longer periods of time compared to occupational exposure (Lucchini, 2010). However, Mn accumulates in the brain over time, and temporal considerations in exposure are gaining recognition as important determinants in human neurotoxicity (Lucchini and Zimmerman, 2009). Even at low doses, chronic long-term exposure to Mn results in neurotoxicity, including delayed and long-term impairment in cognition, motor functioning, mood, and physical health (Lucchini et al., 2009).

Methods: This study examined the impact of environmental manganese (Mn) exposure on verbal fluency among long-term residents of three towns in Southeastern Ohio, USA. Data was obtained from a larger EPA-sponsored study comparing two towns exposed to environmental Mn, Marietta and East Liverpool, with a third, unexposed control town (Mt. Vernon). The current study examined adults residing in their respective town for 50 or more years were examined (East Liverpool: 19 men, 28 women; Marietta: 16 men, 11 women; Mt. Vernon: 8 men and 14 women). 19 men and 28 women from East Liverpool, aged 50 to 75; 16 men and 11 women from Marietta, aged 50 to 73; and 8 men and 14 women from Mt. Vernon, aged 50 to 74. Mn exposure was operationalized as a dichotomous variable based on town of residency. Verbal fluency, an aspect of executive functioning, was measured using the Animal Naming test ($M=107.62$, $SD=15.79$; adjusted for age and education). A hierarchical multiple regression analysis examined the predictive impact of Mn exposure on verbal fluency. Household income and estimated premorbid verbal IQ were entered into the model as covariates. Premorbid verbal IQ was estimated using the WAIS-III Similarities subtest ($M=10.09$, $SD=2.87$).

Results: Exposure predicted verbal fluency scores over and above IQ and income for long-term residents ($R^2_{change}=.045$, $F_{change}=4.45$, $p<.05$), such that exposed residents (East Liverpool and Marietta; $N=66$) have predicted verbal fluency scores 8.248 standard score units lower than unexposed residents ($N=22$).

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Conclusions: These results, taken together with previous research on chronic low-dose Mn exposure, indicate that long-term residency in Mn-exposed towns may be associated with executive dysfunction that cannot be accounted for by differences in age, education, premorbid verbal IQ, or household income.

Note: This abstract does not necessarily reflect EPA policy

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